Studies on the Purification of nonwater Media by ceramic membranes

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- Production and applications of the ceramic membranes (CM), modules and units, based on these membranes, demonstrate the stable rise in Russia. Due to the unique properties of the CM- chemical, microbiological and thermal stability, mechanical strength, possibility of regeneration by rigorous media (acids, alkali solutions) and back-washing, long life-time etc.- they are being employed in many branches of industry and life.
- These advantages of CM, compared with polymeric membranes (PM)- showed the way of their successful application– to replace the PM in the filtration systems in food, microbiological, pharmaceutical branches of industry, potable water treatment systems etc., as well as in processes with rigorous technological parameters, using aggressive, abrasive and highly-viscous media, high temperatures, i.e. in production of ‘clean products’ by ‘clean processes’.

- The great majority of the commercialized technologies using CM deal with water media-filtration of various biomasses in production of vitamines, antibiotics, lizine, purification of enzymes, treatment of milk and corresponding milk products, syrops and wines, purification of potable, mineral and waste waters etc.
- The filtration processes and technologies dealing with nonwater systems, such as various industrial and vegetable oils, different kind of fuels (gazoline, Diesel) are developing, but not commercialized yet.

- **The application of CM in these, environmentally friendly, processes seems very promising and prospective, permitting:**
- **to regenerate and recycle industrial and motor oils, preventing pollution;**
- **to develop new technologies of natural (mostly vegetable) oils' purification instead of traditional processes, demanding high values of energy consumption and producing various kinds of wastes;**
- **to purity various types of fuels, especially Diesel one, from mechanical and colloidal particles, including raisins and sulfur compounds, in order to rise the engines degree of combustion and decreasing pollution.**

Table 1. Characteristics of MF ceramic membranes made of a-Al2O3 (substrate) and coated by a-Al2O3 or ZrO2. Length 800-900 mm, Porosity: substrate 40-45 %, selective layer 40%.

Numbers of channels	Geometry of membrane elements		Pores diameter, mcm		Distilled water permeability, $m^3/(m^2*h*bar)$
	Diameter, mm	Channel diameter, mm	Substrate	Selective layer	
1	8*6	6	3-5	0.8-1.0 0.2-0.4	4.8-5.6 2.0-2.2
1	10*6	6	4-6	1.0-1.5 0.2-0.4	4.8-6.2 1.8-2.0
7	22	4	5-10	1.0-1.5 0.2-0.4	4.4-5.4 1.8-2.0
19	29 (spanner)	3.8	10-15	1.5-2.0 0.2-0.4	4.4-5.0 1.6-1.8

Length 800-900 mm, Porosity: substrate 40-45 %, selective layer 40%.

Table 2: Characteristics of UF ceramic membranes with a-Al2O3 supports. Pressure difference 1 bar.

Selective layers material	Mean pores diameter, nm	Permeability coefficient, $m^3/(m^2*h*bar)*10^3$			Selectivity, %	
		Distilled water	SiO_2 sol	PVP, M=40000 g/mol	SiO_2 sol	PVP, M=40000 g/mol
SiO_2	70 15 3	145 100 50	40 25 12	58 47 32	98.0 99.2 99.9	98.9 99.3 99.6
ZrO_2	70 30 15	400 250 150	50 30 15	110 78 60	98.9 99.1 99.1	66.0 81.5 83.6
TiO_2	70 25 7	610 320 55	57 35 15	90 65 35	97.5 99.3 99.4	72.5 83.2 89.9

The solution tested (table 2) were:
SiO2 sol with solid phase particles of 30 nm diameter, concentration of SiO2- 5% weight
Water solution of PVP (1% weight) with molecular mass of 111-360000

The corresponding experimental parameters and data of filtration processes using CM, (some characteristics of CM used in experiments are presented in tables 1 and 2) in laboratory and pilot scales are presented and discussed.